JANUARY • 1959

ENVIRONMENTAL QUARTERLY

The Pioneer Space Age Publication of Environmental Simulation, Testing, Engineering and Equipment

INDEPENDENTLY PUBLISHED

Volume 5 • Number 1

sure death...

E HUGHES FALCON PROVES ITS RELIABILITY
ROUGH LING VIBRATION TESTING SYSTEMS!

Overcoming destructive vibration forces is an important part of reliability determination at Hughes Aircraft Company.

Both individual components and complete packages such as this production model Falcon (GAR-1D), are qualified through a continuing program of environmental vibration testing, using the many Ling Vibration Systems installed at Hughes.

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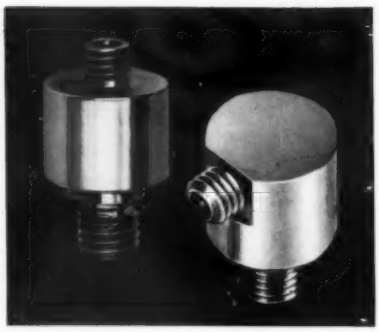

GULTON SHOCK AND VIBRATION DATA FILE

How to avoid false test results due to "ground loop" voltages

Avoid false test results with GLENNITE internally ungrounded accelerometers

Now you can avoid one of the major causes of false test results – spurious "ground loop" voltages – by using *internally ungrounded* GLENNITE accelerometers.

These units contain sensitive seismic elements *internally* insulated from the mounting stud by rugged ceramic insulation. You can employ a *single point ground* at the data handling or recording equipment by using a combination of these accelerometers with ungrounded GLENNITE amplifiers and filters.

GLENNITE accelerometers are available in uni- and triaxial models – wide acceleration and temperature ranges.

A complete line of associated ungrounded electronic equipment includes filters, amplifiers, connectors and other related units.

For complete data on Gulton instrumentation systems – grounded or ungrounded – contact your local Gulton representative or write us direct.

Call in Gulton

From transducer to readout, Gulton is capable of meeting all your instrumentation needs. If you have a measurement problem, why not call in a Gulton Instrumentation Engineer. His broad experience in shock and vibration measurement can prove invaluable to you.

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Gulton Industries, Inc.
Metuchen, New Jersey

With the increasing need for greater accuracy in shock and vibration measurement, extreme care should be taken to avoid the introduction of spurious voltages.

Circulating ground currents, generated by electrical devices external to the measuring system, generate voltages that can lead to completely false results.

GROUNDING USUALLY AT FAULT

Ground loops may come from various extraneous sources.

Figure 1 shows how circulating ground currents in a structure can induce electrical voltages in a typical shock and vibration measuring system. In this example, the accelerometer, amplifier and data handling or recording equipment are placed at three separate locations. Each instrument has its electrical circuitry grounded to the housing, and each housing is connected electrically to the structure at points A, B and C.

Voltages E, produced in the structure by the circulating currents, are introduced into the measuring system between points A&B and B&C.

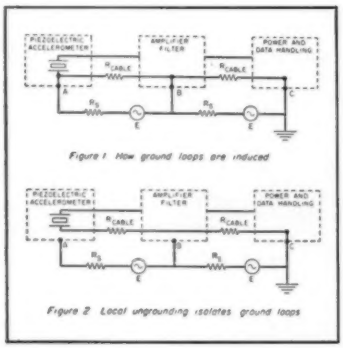

Figure 1 How ground loops are induced

Figure 2 Local ungrounding isolates ground loops

SOLUTION TO THE PROBLEM

First, all electrical apparatus capable of generating currents should be ungrounded and a *single heavy point ground* employed.

Second, all measuring instruments should be ungrounded at local points and the entire system grounded at the single point.

Anthony W. Oriacchio
Chief Engineer
Gulton Instrumentation Division

Figure 2 illustrates a recommended technique for ungrounding the system described in Figure 1. By removing the internal circuit grounds from structural points A and B, ground loop voltages are isolated from the measuring system.

UNGROUNDED INSTRUMENTS THE ANSWER

Today, a new series of Gulton accelerometers and associated electronic equipment is available with *internal ungrounding*.

Accelerometers contain sensitive seismic elements insulated from mounting studs by rugged ceramic insulation.

Filter and amplifier circuitry, as well as connectors, are electrically insulated from the housing which can then "float" at the local ground potential of the mount with no effect upon the measuring signal.

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January • 1959

ENVIRONMENTAL QUARTERLY

Established 1955

The Pioneer Space Age Publication of Environmental Simulation, Testing, Engineering and Equipment

Volume 5 • Number 1

Welcome Reader

. . . to the new ENVIRONMENTAL QUARTERLY. The theme of this issue, the first of Quarterly's fifth consecutive year of publication and the first in an assuredly momentous year for environmentalism, if we may coin a word, might well be "something old and something new." Quarterly is "old" in the sense that it is the pioneer journalistic effort in its field. It is also "old" in the sense that it has become a familiar institution and a voice for all whose goal, if it can be expressed in one word, is reliability.

• From there on, however, Quarterly is new, and you who have known it since its birth and have witnessed its growing pains will sense this quickly. You will note a new approach here, a fresh touch there, and a more interesting presentation throughout. You will find, in fact, a whole series of innovations that add up to a livelier, more intimate and more rewarding magazine than ever appeared before under the name of ENVIRONMENTAL QUARTERLY.

• The newest thing about the new ENVIRONMENTAL QUARTERLY is its ownership. Quarterly now is completely free of the old ties and obligations. No longer a spokesman for any one group, it now speaks for all, for the benefit of all segments of the environmental field. Henceforth Quarterly's advertising and editorial columns are open to all who have a legitimate story to tell.

• What is this new Quarterly? As the following pages demonstrate, and as future issues will show even more clearly, it is a clearing house of ideas, opinions and news. It is a scientific journal. Each issue of Quarterly will bring you carefully written, documented and illustrated reports on some phase of environmental science and simulation, engineering and testing. As in the past, these reports will come from our readers, and we welcome your suggestions and your

(Continued on Page 26)

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Environmental Quarterly, the pioneer publication of environmental simulation, testing, engineering and equipment manufacturing, is an independent periodical published in January, April, July and October by Environmental Publications, Inc.; Martin Z. Post, president and editor, Herman Holstein, advertising and production manager. Devoted to advancing all segments of the industry it serves, **Environmental Quarterly** is affiliated with none. It welcomes competent expressions of opinion but statements appearing on its pages do not necessarily reflect the opinions or judgments of the staff of the Quarterly or of Environmental Publications, Inc. Subscription: $4.00 per year in the U. S. and Canada; other countries, $5.00 annually. $1.00 per copy. **Editorial and business address: P. O. Box 2583, Grand Central Station, New York 17, N. Y.** Printed by Princeton Printing Co., Princeton, N. J. Copyright © 1959, by Environmental Publications, Inc.

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ENVIRONMENTAL QUARTERLY

JANUARY • 1959 Vol. 5 • No. 1

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AROUND THE ENVIRONS...

Chicago, Ho! for Third Annual IEE Meeting and Show in April

Environmental scientists, engineers and manufacturers will be Chicago-bound in April for the third annual meeting of the Institute of Environmental Engineers. The technical meeting and associated exhibit of environmental equipment and instrumentation will be held from Wednesday through Friday, April 22-24, at the Windy City's La Salle Hotel.

On tap are discussions of the hyper-environment and its effects, environmental problems of testing aircraft, missiles and possible spacecraft of the future.

Plans for the convention are under the general direction of IEE President Roger J. Amorosi, who heads Parameters, Inc., Garden City Park, L. I. and IEE General Manager John Regazzi, who is chief of the Arma Division's environmental section at Roosevelt Field, L. I. Arthur B. Billet, IEE vice president, fiscal affairs, who is senior staff engineer of Vickers, Inc.'s, Aero Hydraulics division in Detroit, is chairman of the meeting committee. He is being assisted by Raymond Yaeger, of the Chrysler Corp., program committee chairman, and Ernest Corduan, of Vap-Air, Chicago, who heads the facilities, publicity and registration committee, among others.

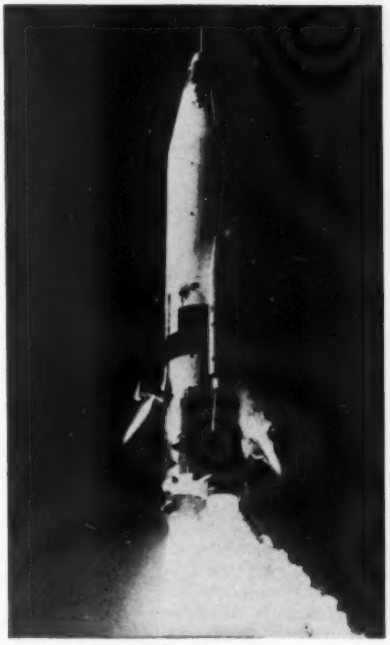
Details on reservations and exhibit space are available from IEE 1959 Annual Meeting,, P. O. Box 97, Arlington Heights, Ill.

• • •

The 39th annual meeting of the American Meterological Society will be held in New York at the Barbizon-Plaza Hotel January 26-29. The National Society of Professional Engineers is sponsoring an Engineering Progress Exposition June 17-20 at the Commodore Hotel, New York. The Sherman Hotel, Chicago, will be the site of the 1959 Corrosion Show to be held concurrently with the 15th annual conference of the National Association of Corrosion Engineers.

• • •

The Army is pleased with the savings from using carbide-tipped gun drills to drill stationary workpieces of high alloy steel. It says it is possible to produce a hole in one pass that will have less than .002-inch per foot run-out, a diameter within .0005 inches of the prescribed dimension and a surface finish smoother than 16 micro inches.



Electronic Sales Hit New Peak in '58

Sales at the factory of all kinds of electronic products hit a record high of $7,700,000,000 last year, a cool hundred million dollars above the 1957 peak. But, says David R. Hull, president of the Electronic Industries Association, the gain was "modest," reflecting reduced capital outlays and military procurement.

Military needs nevertheless are pacing the electronics industry, with missiles and aircraft accounting for some 70 per cent of $4,100,000,000 manufacturers sales to the military. Hull expects two billion dollars to be spent on missile electronics this year, with aircraft guidance systems taking an additional $1,400,000,000.

• • •

Additional Moon Shots Urged

Less than an hour before the jubilant Soviet announcement that Russia had launched its moon rocket, the House Committee on Astronautics and Space Exploration started the new year with an urgent recommendation that the White House order two additional moon shots as quickly as possible. It said the Air Force had necessary equipment at Cape Canaveral but no plans for using it. On tap at the time was the Army launching slated for early February, the second of two planned shots. The Air Force had scheduled—and completed—three lunar probes.

Contract Cancellations . . . And Some New Awards

A rash of contract cancellations, apparently inspired by an economy drive, left the Regulus II guided missile as one of the more spectacular victims. The Navy spent 78 million dollars on the Regulus with Chance Vought Aircraft, Inc., but wanted to save 100 millions in earmarked funds for other weapons. It was Chance Vought's second blow in two days. The first was cancellation of its 100-million-dollar Crusader III jet plane contract when the Navy, under Congressional orders, picked McDonnell Aircraft Corp.'s competing F4H-1 as its sole all-weather fighter.

The Air Force disclosed that the cancelled Rascal missile program had cost 374 million dollars. Bell Aircraft Co., of Buffalo, was the contract holder. The Air Force said its Rascal experience would be valuable in work on the successor Hound Dog missile, for which North American Aviation, Inc., Los Angeles, is prime contractor.

Cancellation of the lightweight, air-breathing Goose missile early in December, after an investment of about 58 million dollars, was followed by annulment of Fairchild Engine and Airplane Corporation's contract for J-38 engines, which the Goose would have used.

Boeing Aircraft Co. awarded a contract of more than 10 million dollars to Westinghouse Electric Corp's Air Arm division at Baltimore for target seeker guidance systems for the Bomarc missile. Goodyear Aircraft Corp. won a $1,700,000 contract for ATRAN nose sections for the Mace missile. The Mace, Glenn L. Martin Co., prime contractor, is a surface-to-surface unit now in final stages of development at Holloman Air Force Base, N. M.

Still several years away from active service, the Army's Nike-Zeus anti-missile missile is reported to have graduated from the drawing board to the hardware stage.

• • •

One of the major problems to be overcome in the development of a nuclear reactor for rocket propulsion is extreme heat. Materials must be found, says Dr. R. E. Schreiber, of the University of California's Los Alamos, N. M., scientific laboratory, to withstand temperatures of more than 2,000 degrees C. The lab is studying the possibility of rocket propulsion by a series of small nuclear explosions.

(*More on Page 28*)

The low-cost answer to fast, accurate testing of components under simulated operational g-forces as required by MIL-E-5272A.

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The building block design concept gives the new centrifuges exceptional flexibility. Machines are assembled from six basic off-the-shelf components; drive system, drive motor, boom, test compartment, console and accessories. You simply select components which provide features needed to meet your specific requirements. Interchangeability of the components permits easy modification as requirements change. Kits are available for modification by the customer.

This new design concept also results in manufacturing economies which are reflected in the cost of the machines. *The new machines are the lowest priced centrifuges now available—in spite of their greater accuracy, flexibility and capacity.* Ask your Genisco representative for complete information today.

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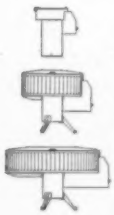
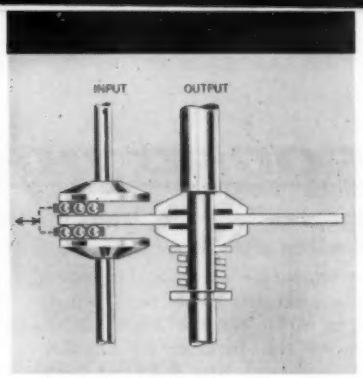
brief performance specifications



Model No.	Diameter	Test Object Weight	Capacity G-pounds	RPM Max.	G-Range Max.	Test Object Dimensions
A-1010	30" table	50 lbs. dead weight	2,500	800	.1 to 200 g's	
A-1020	60" arm	100 lb. dead weight	10,000	600	.1 to 250 g's	12" cube
A-1030	96" arm	100 lb. dead weight	10,000	400	.1 to 175 g's	18" cube

Large custom centrifuges: Genisco centrifuge experience includes the design, manufacture and installation of large custom-built machines. We invite your inquiry.



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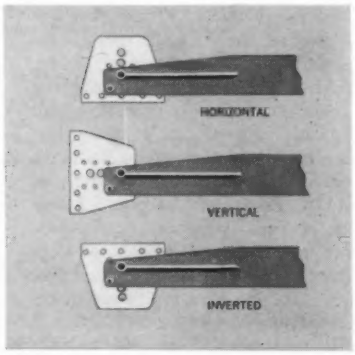

Basket-type mounting platforms, available on Model A-1020 and A-1030, may be oriented from the horizontal to the vertical or to the inverted attitude for multiple-axis testing without demounting the test object. Baskets may be raised or lowered to achieve an optimum dynamic balance and minimum angular deflections when extreme accuracies are required. When the basket is inverted the outside surface of the platform may be used to mount bulky, lightweight packages.

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Prediction of Missile System Survival in a Vibration Environment

by
George F. Christopher
Edwin D. Karmiol
John S. Youtcheff
General Electric Co.
Missile and Space Vehicle Dep't.

Missile equipment can be evaluated and its ability to withstand operational vibration stresses predicted through an integrated environmental test program and sequential life analysis. The value of this program has been established on ballistic missile systems and other vital defense projects, where high operational survival is mandatory.

In predicting the probability of missile system surival in a vibration environment, three major areas must be investigated: The operational environment, the adequacy of present test activities and methods of making optimum use of all available test data.

Missile system environmental considerations can be divided into the pre-flight operation, covering the ground phases from system assembly to launch, and the flight operation, covering the flight trajectory from the point of launch to the assigned target. The overall environmental requirement is a factor of the stresses encountered in these two operational areas.

The flight operation is of prime importance because the equipment is beyond the reach of maintenance activities while being subjected to the highest operational stresses and functional demands. It can be sub-divided into three major flight phases; the initial or launch phase, the mid-course phase and the terminal phase. For a ballistic missile as is considered here, these phases become the powered flight phase, the free-flight phase and the re-entry phase.

FLIGHT VIBRATION ENVIRONMENT

	I		II	III
PHASE	INITIAL PHASE		MID-COURSE	TERMINAL PHASE
BALLISTIC MISSILE PHASE	1ST STAGE POWERED FLIGHT	2ND STAGE POWERED FLIGHT	FREE FLIGHT	RE-ENTRY
TIME IN PHASE	T_{IA}	T_{IB}	T_{II}	T_{III}
VIBRATION LEVEL	AMPLITUDE: a_{IA} FREQUENCY: f_{IA}	AMPLITUDE: a_{IB} FREQUENCY: f_{IB}	——	AMPLITUDE: a_{III} FREQUENCY: f_{III}

(Figure 1)

The powered flight phase can consist of one or more stages of active propulsion, terminating at engine shut-off which occurs after a specified time period when ballistic velocity is reached. The free-flight phase extends from engine cut-off to a point on the trajectory at which the ballistic missile re-enters the effective atmosphere. The re-entry phase extends from the point of atmospheric contact to the point of impact.

PRE-FLIGHT VIBRATION ENVIRONMENT

	I	II	III	IV
PHASE	TRANSPORTATION PHASE	STORAGE PHASE	HANDLING AND MATING PHASE	PRE-FLIGHT CHECKOUT PHASE
TIME IN PHASE	T'_I	T'_{II}	T'_{III}	T'_{IV}
VIBRATION LEVEL	AMPLITUDE: a'_{I_1} FREQUENCY: f'_{I_1}	——	——	AMPLITUDE: a'_{IV} FREQUENCY: f'_{IV}

(Figure 2)

Vibration stresses can be analytically estimated in each of these flight phases (Figure 1), and equipment vibrational amplitudes and frequencies can be estimated for each stage of propulsion, where the vibrational stress is of the longest time duration. Although the free-flight phase accounts for over three-quarters of the flight time, operational conditions are such that vibrational stresses are effectively zero. While high vibrational stresses can be encountered during the re-entry phase, the time involved is of extremely short duration. Thus vibrational environmental considerations need be di

The authors developed the material on which this article is based for a symposium held last year in San Diego. Mr. Christopher is the functional engineer, vibration analysis, at GE's Missile and Space Vehicle Department in Philadelphia. A 1950 graduate of RPI with a master's from Ohio State, he has had extensive experience in guided missile work. Mr. Karmiol is manager of the reliability programs and design review operation at the M and S V Department. He received his BS in electrical engineering at the University of California in 1948 and was

George F. Christopher

Edwin D. Karmiol

John S. Youtcheff

with Allen B. DuMont Laboratories before joining GE. Mr. Youtcheff, who majored in physics at Columbia, worked at the Naval Air Missile Test Center, Point Mugu, Calif., while doing graduate work at the University of California. He is functional engineer in charge of reliability analysis at the GE department, where he has been instrumental in setting up programs for several long-range ballistic missiles.

rected only to the first and last phase of ballistic missile flight and can be confined to limited time, frequency and amplitude levels.

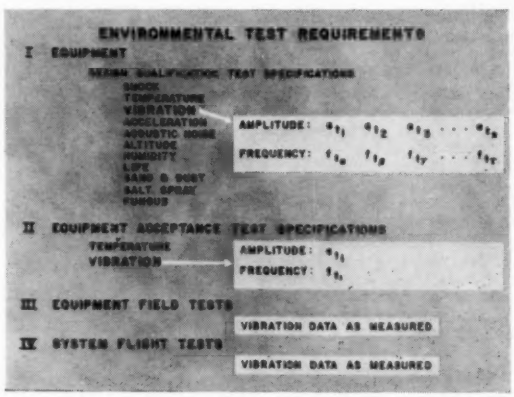
The same approach applies to environmental stresses in the pre-flight operation, which can be divided functionally into transportation, storage, handling and mating, and pre-flight check-out. Here consideration must be given to packaging and other means of protecting the missile system and associated equipment from recognized detrimental environment, and ground environmental stresses can be established for each pre-flight operational phase (Figure 2).

Transportation being the longest period of any vibrational stress in the overall missile operation, equipment vibrational amplitudes and frequencies can be obtained for each mode. Storage times are apt to be of extremely long duration, but the vibrational environment need not be considered in this phase. Similarly, no vibrational stresses of any consequence are likely to be encountered during the handling and mating phase. In the pre-flight check-out phase, however, vibrational stresses will be experienced during periods of captive flight when the engine is operating.

It is thus possible to establish the vibrational environment that the missile system, and associated equipment, will be subjected to in various phases of flight and pre-flight operations. The time periods at the various stress levels, together with equipment functional requirements within these time phases, are utilized with available test data in the prediction analysis.

System Environmental Testing

There are four major test activities in any missile development program: Design qualification testing, equipment acceptance testing, field testing and flight testing. Within the



(Figure 3)

overall test program, design qualification tests are of major importance in providing equipment environmental data. They permit examination of the stress levels which it is anticipated the equipment will be subjected to in operational usage, allowing the establishment of adequate environmental test limits, and provide system operational data relative to vibrational and other environmental stresses as specified (Figure 3).

Equipment acceptance requirements include specific temperature and vibration testing to insure detection of workmanship defects and incipient flaws in the production items. This testing provides additional data regarding the behavior

(*Continued on Page 17*)

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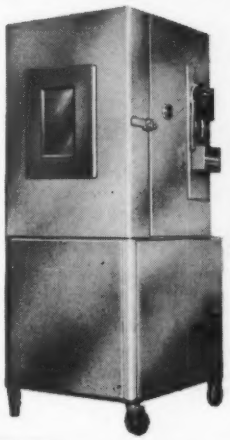

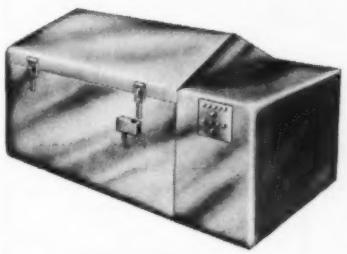

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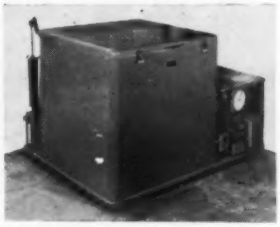
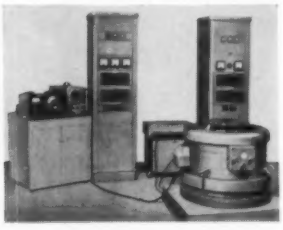
NEW PRODUCTS...

A "Reader Service Card" requiring no postage is bound into this issue for the convenience of those desiring additional information on new products, new literature (Page 23) and other announcements. It is keyed in the text as "EQ RSC."



Industrial low temperature chamber by Cincinnati Sub-Zero Products quick-ages the newest stainless steels used in aircraft and missiles. Also for production chilling in general. Designated 4SR-120-64, the unit has 64 cubic feet (inside dimensions: 48x48x48", outside: 60x72x96"), and can bring 350 pounds of AM350 stainless steel per hour from +80 to -120 degrees F., where net thermal capacity is about 8,500 BTU per hour. Chilling chamber is galvanized, electric welded liquid-tight, with mechanical air convection.

For More Information Circle EQ RSC #1



Genisco-Savage vibrating and fatigue testing system capable of thrust of ±3,000 pounds, 5 to 5,000 cps, consists of a V1001 vibrator, 10K amplifier and Type 1001 D-C field supply. By **Genisco, Inc.** Continuous rating of the amplifier is 10,000 watts at frequencies from 40 to 10,000 cps. Meets requirements of MIL-E-5272A, MIL-E-005272B and MIL-E-5422D, among other specifications. Console construction. Vibrator, stress-tested to withstand continuous operation at an acceleration level of 100 g's, can accommodate objects up to 2,000 lbs. dead weight without external support.

For More Information Circle EQ RSC #2

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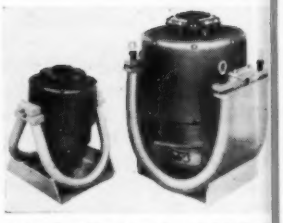
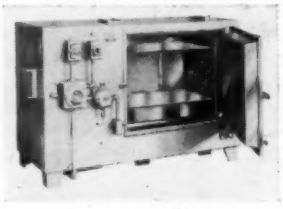
Two wide-band electrodynamic shakers of improved new design from Ling Electronics, Inc. Model 219 is rated at 500 pounds force output, Model 227 at 150 pounds. Elimination of all secondary structural resonances is claimed, so that the armature behaves as a simple single degree of freedom system over an extended frequency range. Model 219 is 29 5/8" high, 24" wide, 18" deep, weighs about 1,025 pounds and has a 7.5-pound armature of extruded webbed aluminum construction which allows a high first bare table resonance of 6,000 cps, or 4,000 cps with a 14-pound load.



Model 227 is 21 1/2"x16" 18 1/4", weighs 350 pound and has a 1.75-pound arma ture which maintains a firs bare table resonance of mor than 9,000 cps, or 7,000 cp with a 1.81-pound load, an 6,000 cps with a 3.44-poun load.

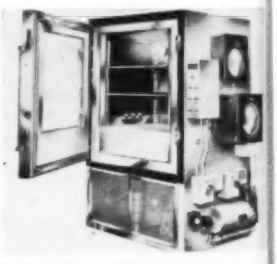
For More Information Circle EQ RSC #3



Hazard-Safe Ovens, by Blue M Electric Company, feature explosion-proof ball bearin motor, totally enclosed aut matic thermostat and suc safety features as exce temperature cut-off and aut matic disconnect of electrica circuits if door is opened b internal pressure or manually Modella heater bank operate at "black heat." Bench an floor models available. De signed according to Under writers' Requirements (Clas 1, Group D).

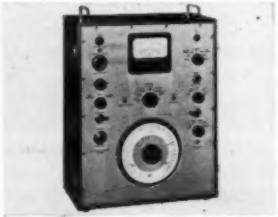
For More Information Circle EQ RSC #4

Weatherlab, a new line of combination high and low temperature-humidity environmental cabinets is being marketed by the **Hudson Bay Co., division of Labline, Inc.** Models from five cubic feet to walk-in sizes can sustain temperatures from —120 to +350 degrees F, humidities from 20% to 90%. Heavy double-wall construction, with corrosion resistant Monel metal interiors, stainless steel exteriors, vapor sealed Fibreglas insulation. Refrigeration piped as compound or cascade as required by use of F12, F22, or F13. Cushion



mounted compressors. Re corder-controller program mers available for cycling o erations. Prices start a $1,000.

For More Information Circle EQ RSC #5



Bruel and Kjaer, Denmark, audio frequency spectrum analyzer, featuring true RMS, average and peak readout, switch selected, is bein marketed by **B & K Instru ments, Inc.** Of the 1/3 octav filter type, with center fr quencies from 40 to 32,00 cps, it has these characte istics: tops flat within ± 1/ db, steep sides with max mum slope of 120 db pe octave, skirt selectivit greater than 50 db per octav and greater than 70 db per octaves from the center fr quency. May be used wit B & K's Model 2304 leve recorder.

For More Information Circle EQ RSC #6

Versatile single-axis flight simulation table, Model A916, by **Genisco, Inc.,** for testing airborne components under simulated pitch, yaw and roll maneuvers, is actuated hydraulically and may be used with an analog computer, function generator, tape recorder and digital-to-analog converter. Performance specifications given by the manufacturer include: Range—±15 degrees maximum rotation. Resolution—±2.5 seconds of arc. Amplitude response—flat within ±2db to 45 cps. Maximum angular rate— 310 degree/sec. @ 1 gal./min. transfer valve; 155 degree/sec. @ 1/2 gal./min. transfer valve. Maximum available torque—2,220 lb-in. @ 300 psi. Platform size—1/2x18x18".

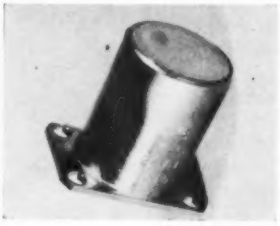
For More Information Circle EQ RSC #7

United Electric Controls Company: A remote bulb temperature control, Type 27A, with two switches, which has many applications in air conditioning. Available with range spans of 100 or 200 degrees F. between limits of —150 and + 650 degrees F., and with on-off differentials of approximately one and two degrees.

Two new **UE high pressure models,** No. 670 and 680, are applicable to the following controls: J51, minimum size; J7, compact; J11, heavy duty, shock resistant; J95, explosion-proof; J6, watertight, and H98, explosion-proof with external calibrated dial and knob. The new models extend the present maximum of 600 PSI to 1,700 PSI. Five new models have been added to **UE's lightweight pressure control** style J40. Suitable for air, gas or liquid pressures, the new models have phosphor bronze bellows permitting differentials as close as 12 ±4 ounces.

For More Information Circle EQ RSC #8

Miniature solenoid, Model R.S. 5178, by **Rocker Solenoid Company,** a subsidiary of Telecomputing Corporation, features ultra-high speed response and will operate with a 10-pound load. Designed to operate over an ambient temperature range of —65 to +250 degrees F., it has a .015-inch store which starts at a maximum of 6 milliseconds and is completed at less than 13 milliseconds from closing circuit.



For More Information Circle EQ RSC #9

Precision pressure switch, consisting of a contactor manometer and a 110V A.C. relay-power-supply package tradenamed Manotac, by the **Meriam Instrument Co.** May be used for alarm signalling and/or control in applications involving pressure, vacuum, differential pressure, oil flow and liquid level. Special indicating fluid gives control sensitivity of .005 in. of water, and the instrument can sense pressure increments as small as .003 oz. per sq. in.

For More Information Circle EQ RSC #10

(More on Page 19)

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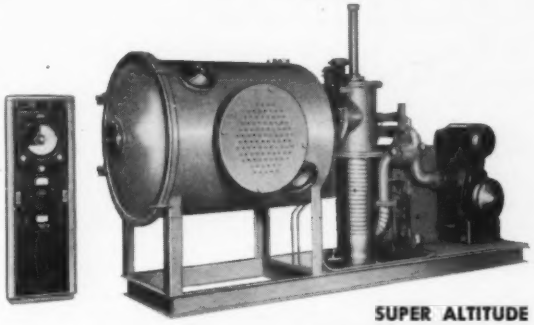

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ALTITUDE PERFORMANCE TESTING . . . . of Fuel Pumping Sub-Systems

by Alan E. Wilkis
Supervisor, Fuel Systems Laboratory
McDonnell Aircraft Corporation

The important functions of fuel pumping sub-systems in modern weapon systems and the complexity of detailed analytical analysis of these sub-systems dictates laboratory evaluation and analysis under conditions closely representing those experienced during flight.

Mr. Wilkis' career has been as spectacular as the modern aircraft he works with. At 26, he has been supervisor of McDonnell Aircraft Corp.'s fuel system laboratory for one year, and for 2½ years prior he was in charge of fuel system tests for the F-101. He was graduated from Tri-State College, Angola, Ind., as a mechanical engineer in 1952.

Alan E. Wilkis

In weapon systems incorporating engines that consume liquid fuels, pumping sub-systems supply the fuel from a main tank to the engines and maintain the main tank fuel level from auxiliary tanks to make all the fuel load available. Failure to provide these "services" in the necessary proportions results in engine starvation and termination of powered flight. Fuel pumping sub-systems are employed for other direct purposes like "buddy" refueling, and for indirect purposes like control of longitudinal and lateral balance.

As the overall scope of weapon systems continues to evolve, the task of providing compatible fuel pumping sub-systems becomes more difficult. Increasing consumption rates of the engines, increasing climb rates, higher final altitudes, high vapor pressure fuels and higher fuel temperatures mean that more space is required, more power is required to operate the pumps and greater weight allowances are required. The design of the pumping elements becomes more complex because discharge flow requirements increase and vapor handling to prevent cavitation is made more difficult.

An Assumed Sub-System For Test

Figure 1 is a schematic diagram of assumed fuel pumping sub-systems for a manned interceptor and Figure 2 shows altitude and engine consumption requirements for the aircraft during an assumed take-off and climb with maximum capabilities. Considering the sub-system with the function of maintaining the main tank fuel level as being under laboratory evaluation, Figure 3 shows assumed requirements for each transfer pump during the same interception mission.

Methods Of Testing

Several aspects of testing can be employed to determine if the transfer pumps can meet the requirements. One aspect is the evaluation of a single pump to determine characteristics under constant or variable conditions.

Figure 4 is a schematic diagram of a test set-up employed to determine constant altitude performance characteristics of the transfer pump. The pump is calibrated for discharge flow and pressure capabilities and power consumption under various pre-set conditions of altitude and fuel temperature. Figure 5 shows typical test results that can be used to determine if the pump meets the Figure 3 requirements by calculating the pressure loss characteristic of the discharge line used by the pump (Fig. 1) and comparing pressure-flow points between Figures 3 and 5 at comparable pressure altitudes. This data has basic value, but can be misleading since rate of vapor for-

(Continued on Page 12)

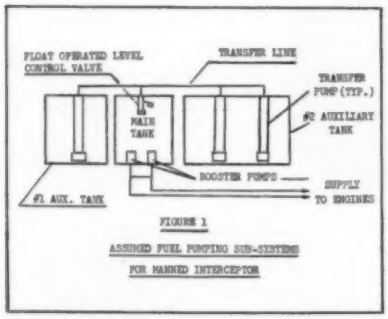

FIGURE 1
ASSUMED FUEL PUMPING SUB-SYSTEMS FOR MANNED INTERCEPTOR

(Figure 1)

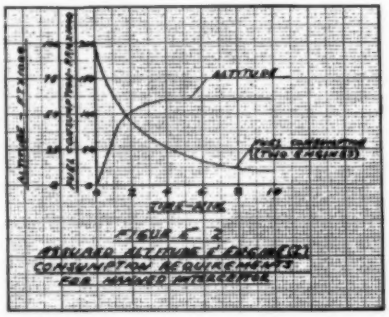

FIGURE 2
ASSUMED ALTITUDE & ENGINE(S) CONSUMPTION REQUIREMENTS FOR MANNED INTERCEPTOR

(Figure 2)

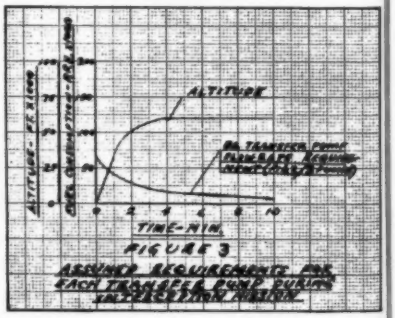

FIGURE 3
ASSUMED REQUIREMENTS FOR EACH TRANSFER PUMP DURING INTERCEPTION MISSION

(Figure 3)

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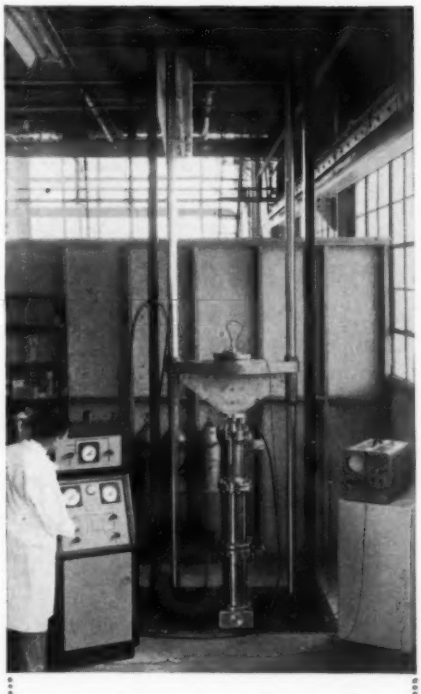

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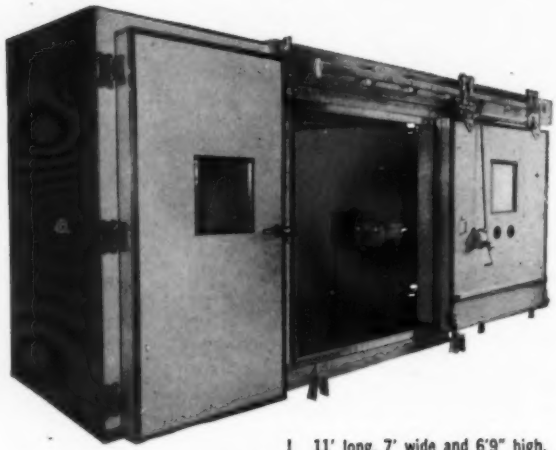

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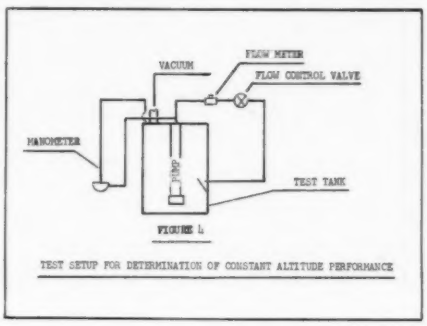
Altitude Performance Testing

(Continued from Page 10)

mation (fuel "weathering") can vary between the constant altitude test and the actual "climb to altitude" such that pump discharge characteristics are affected.

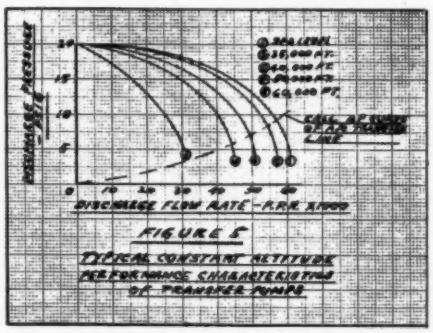
Figure 6 is a schematic diagram of a test set-up employed to determine "climb to altitude" performance characteristics of the transfer pump by programming the fuel flow and altitude to correspond with the requirements of Figure 3. Determination of compatibility of the pump to requirements is precluded during test. If the pump delivers the flow rate required throughout the climb and discharge pressure meets or exceeds the pressure loss characteristic of the aircraft discharge line the pump is acceptable. However, the test does not coincide



(Figure 4)

with actual aircraft conditions since the level control valve does not program the flow rate, but monitors only with respect to fuel level, cracking pressure and pressure loss characteristic.

The test set-up of Figure 6 can be employed to determine "climb to altitude" performance characteristics of the transfer pump under pre-set line loss characteristics by adjusting and maintaining the fuel flow programming valve to a setting



(Figure 5)

that provides test set-up simulation of the line loss between the pump and the level control valve (Fig. 1) and installing the actual level control valve at point "A". With this variation only pressure altitude is programmed and pump discharge characteristics are allowed to vary in accordance with the effects of altitude. Acceptability of the pump is determined as with the method of programming fuel flow.

Another aspect of testing is the simultaneous evaluation of all the pumps in the sub-system. Figure 7 is a schemati

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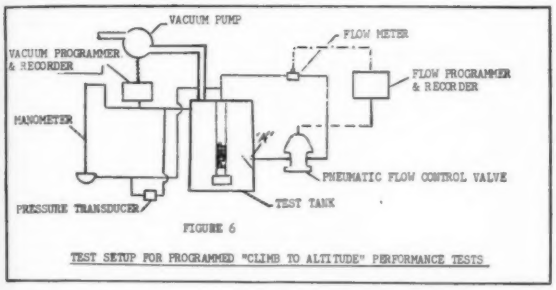


(Figure 6)

diagram of a test set-up employed for pumping system testing.

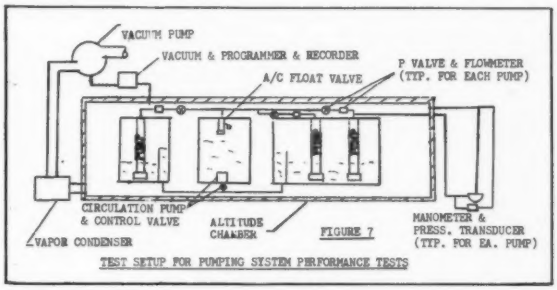
Line loss characteristics from each pump to the transfer valve (or valves if the system should include an auxiliary main feed tank containing a level control valve) is simulated by installing the pumps in a scale mock-up of the system made of actual aircraft parts, measuring the discharge pressure of each pump with the transfer valve(s) accepting fuel, installing the pumps in the test set-up and adjusting valves in each line such that the pumps have the same discharge pressure balance. Total flow through the level control valve and flow provided from each pump will then be the same in the set-up, under any altitude condition, as it would be in the aircraft.

The fuel in the test chamber is heated to test temperature by steam heat exchangers, preferably external of the set-up, by circulation before test. Fuel temperature is maintained to provide the worst condition of true vapor pressure expected in flight. Fuel samples are taken before, periodically during and after test for determination of Reid Vapor Pressure, specific gravity and viscosity.

Because of the large amount of fuel involved and greater surface area (than in individual pump tests) vapor evolution can make attainment of altitude, especially rate of climb, difficult. A vapor condenser can ease this condition and reduce the vacuum pumping capacity required.

Fuel is recirculated from the "main tank" to the "auxiliary tanks" in the test set-up by gravity interconnects and by a secondary pumping system. Additional simulation of actual

(*Continued on Page 24*)


VACUUM PUMP
VACUUM & PROGRAMMER & RECORDER
P VALVE & FLOWMETER (TYP. FOR EACH PUMP)
A/C FLOAT VALVE
CIRCULATION PUMP & CONTROL VALVE
ALTITUDE CHAMBER
MANOMETER & PRESS. TRANSDUCER (TYP. FOR EA. PUMP)
VAPOR CONDENSER
FIGURE 7
TEST SETUP FOR PUMPING SYSTEM PERFORMANCE TESTS

(Figure 7)

AR

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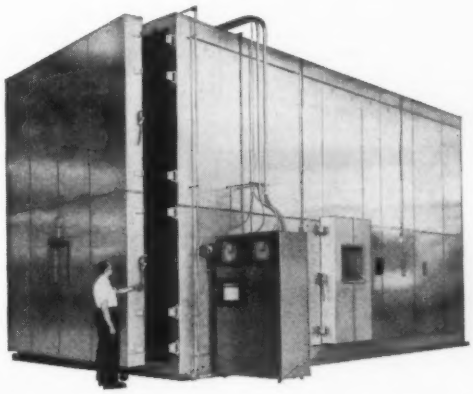
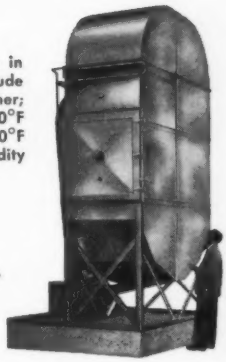


◀ Altitude chambers in any size — Altitude 200,000′ or higher; temperature +500°F and higher to −100°F and lower; Humidity 20% to 95%.



Sand and dust chamber ▶ includes automatic dust density control and streamlined air-flow design.

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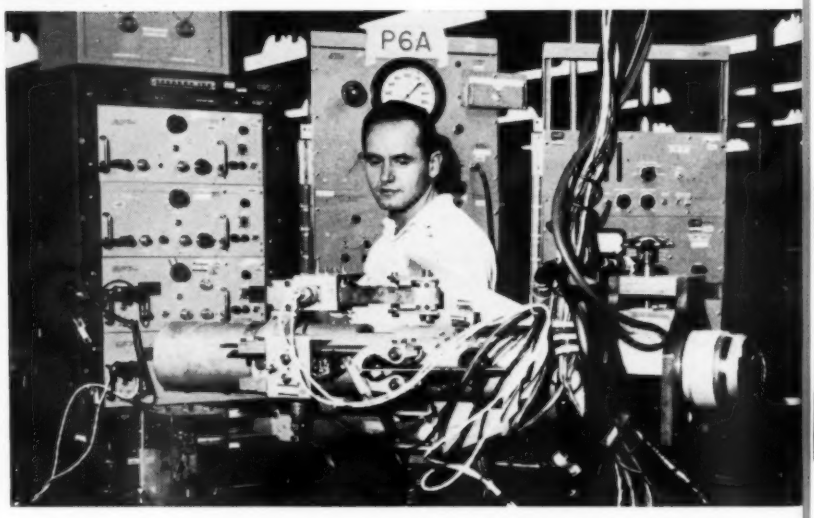
Environmental Quarterly's Album of People,

MOON STRUC-TURE No telling if it's the man in the moon's dream house, but the Wonder Building Corp. of Chicago, thinks the moon building (left) could make wandering earthlings comfy. Note the shield, 83 feet up to ward off the moon's gnatlike meteor rain. Aluminum alloy structure can "float" if necessary, on a sea of moon dust. Moon building was designed and engineered by Wonder under the technical direction of Dr. John S. Rinehart, of the Colorado School of Mines.

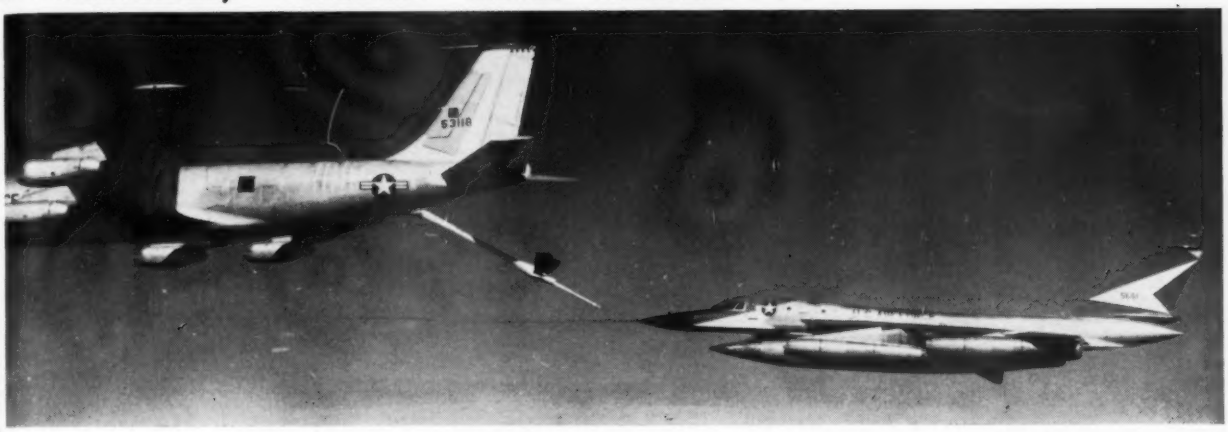
TNY spells Tenney Engineering Co. Inc., to traders on the floor of the American Stock Exchange, which began listing Tenney stock last month. Trio at the left happily discussing the changed Exchange environment are John J. Mann, Amex governor (center), and Monroe Seligman (left) and Saul S. Schiffman, president and board chairman, respectively, of Tenney, one of the oldest and largest environmental test equipment manufacturers.

SIDEWINDER. First production photo (below) shows the deadly missile's infrared "eye" and complete guidance and control system being checked out on simulated flight test equipment at Philco Corp's government and industrial division plant in Philadelphia. The air-to-air missile has been in operational use for more than two years with the Navy's 6th and 7th fleets, and the Air Force has it on its new Lockheed F-104A jet fighters. Sidewinders destroy by homing in on the infrared radiations (heat) of an enemy jet's exhaust, and zoom . .

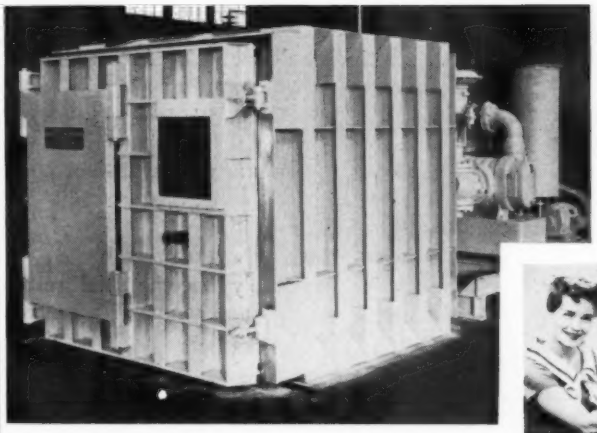
VETERAN in a new firm. Al Deeb (above) is general manager and sales manager of ITEMCO, Inc., which began producing environmental chambers early last summer. But he and his key aides are old hands at creating environments. (See Page 21.)



Products, Places and Ideas . . .



HUSTLING OVERHEAD Somewhere over Texas not long ago. A Mach 2 B-58 Hustler manuevered into position under a KC-135 tanker for the first refueling aloft of the world's fastest bomber, and the above picture resulted. B. A. Erickson, Convair Division (Fort Worth's) chief test pilot, was at the controls of the Hustler. He said he made two practice passes before accomplishing the hookup. The Hustler can do more than 1,300 miles per hour.



HIGH AND TINY. Two recent additions to the environmental scene are General Vaccum Corp.'s very high altitude chamber (above) and Mantec's miniature unit (right). For details on the GVC line, which can get up to around 300,000 feet in 10 minutes, see Page 20. For more information Circle EQ Reader Service Card #34). Mantec's midget, Model D-106, is 28 x 16 x 15" overall, is available with top or side loading, and will maintain —65 degrees F. for 12 hours without replenishment of dry ice refrigerant. (For more information Circle EQ RSC #35).

HE GIVES A PLUG. Robert J. Cannon (left) gives the 100,000, 000th Cannon Electric Co. plug to Donald Douglas, Jr., president of Douglas Aircraft Co. (EQ RSC #36).

JOHN M. PEARCE
Electronics Chief
(See Page 25)

FRANK S. WYLE
Heads Merged Firms
(See Page 20)

MAX A. PAPE
Alumni Executive
(See Page 25)

ARTHUR W. MILLER
Production Veteran
(See Page 25)

by
T. F. Foti

Design Support Dep't.
Martin-Baltimore

TAILOR-MADE TEST BENCH

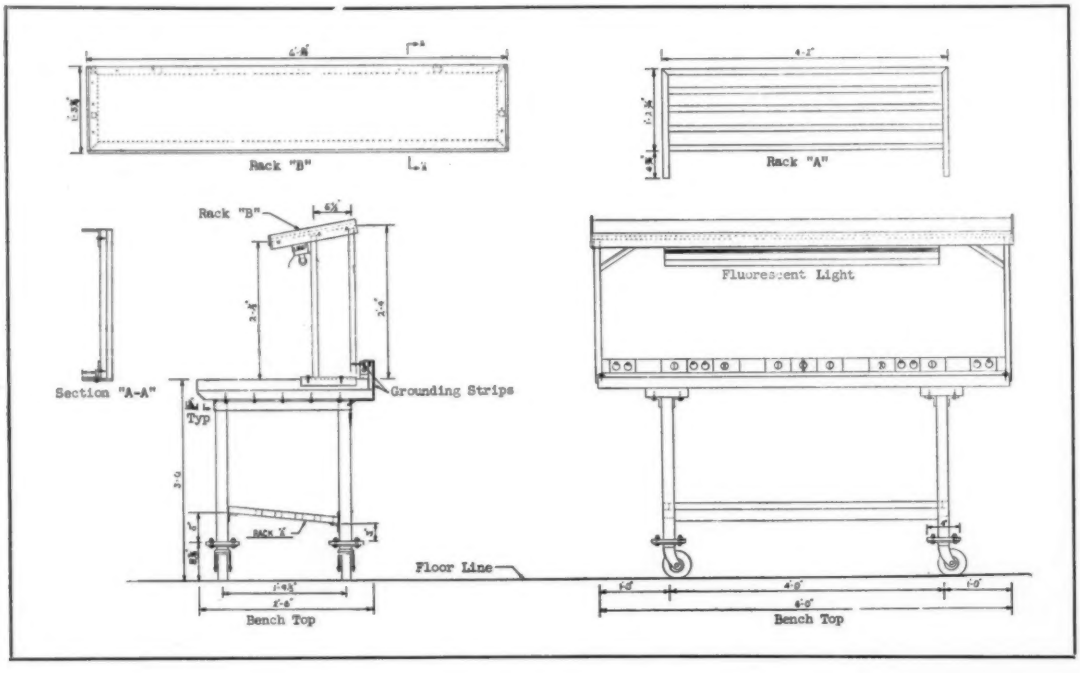
for Environmental Laboratory

Shown on this page are various views of a very handy bench, designed especially for the testing done at the Martin Environmental Laboratory. With it, the test set-up made when a program starts can be kept intact while the specimen is moved from one test facility to another.

The design combines ideas suggested by all laboratory personnel, who scrounged parts for a prototype. This hand-built job proved so successful (it's still in use) that the design was further improved and formalized by our engineering facilities group and put into quantity production to replace the old fixed benches.

The bench top, 6 x 2½ feet, was felt to be the largest possible size consistent with the need for mobility. Sufficient space for the usual mountain of electronic test gear is furnished above and below the top by equipment racks which slope for visibility. Along the back edge of the top is a strip containing convenience outlets for the four currents used in this laboratory. Four 25-foot power cables serve this strip.

All four wheels are castored. The pair at one end have locking pins, making the bench maneuverable by one man. Drawers, which inevitably become final resting places for such things as tubes and scraps of wire, were deliberately omitted.



Missile System Survival

(Continued from Page 7)

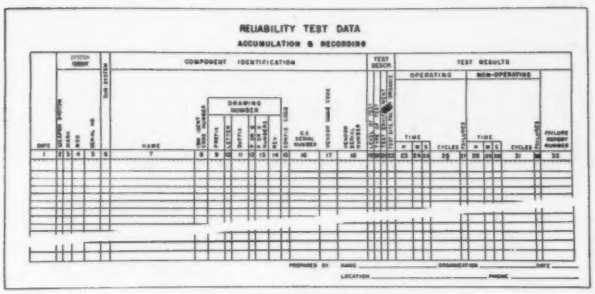
of the equipment under a reduced vibrational environment. In addition to the qualification and acceptance environmental testing, equipment vibrational data is also obtained as measured during the field and flight test activities in the later stages of the missile system development program.

This environmental test data is used as inputs for the reliability data analysis, from which the probability of equipment survival under vibration and the other various operational stress levels can be ascertained. Thus all test data obtained throughout the development program is utilized to the fullest extent in the prediction of system survival in its functional environment.

Predicting System Survival

Test data accrued from all functional and environmental tests can be recorded in a reliability data log containing provisions for equipment test time, test environment and test results (Figure 4). This data log provides a test history and can be utilized in statistical analysis of equipment operational life.

The prediction analysis employs a sequential life testing plan utilizing both component and system test data. Basically, the equipment tested represents a sample of one or more units subjected to phases of the operational environment for a given test period. The number of failures, if any, is noted and the results used in estimating the probability of survival in the vibration as well as other operational environments. It is also possible to determine the amount and type of testing required to insure a specified survival probability, and tables can be utilized to obtain equipment survival probability values for various test times and test results as sequentially ac-



(Figure 4)

crued in the equipment testing (Figure 5). These tables provide a means of keeping track of equipment reliability in a given operational environment as results accumulate during various test phases of the missile development program.

This prediction method requires that the equipment failures in the area of interest are subject to an exponential chance-failure curve. This can be vertified or modified as test data is accrued on the various system components. In obtaining the test data, the system equipment, on which the unit test time is accrued, must be from the same population as the

(Continued on Page 18)

HARRIS 2-CHAMBER UNIT GIVES DOUBLE TEST CAPACITY— HIGH OR LOW TEMPERATURE OR BOTH

Harris ingenuity, traditional since 1934, is exemplified in this double chamber environmental testing unit. The two chambers are completely separate and independently controlled, though chilled by a single refrigeration machine. Both provide complete temperature range from —125° F. to +250° F. Both may be operated simultaneously at either temperature extreme, or one may be set for low temperature and the other or high temperature testing. This exceptional versatility at least doubles the unit's capacity since two separate tests may be run at the same time. In use by several major electronic manufacturers, it has proved dependable, effective, and highly economical for production testing.

SPECIFICATIONS: **Outside dimensions — 74" long x 36" deep x 76" high. Net free working area in each chamber — 24" x 24" x 24" (8 cu. ft.). Temperature range: —125° F. to +250° F.**

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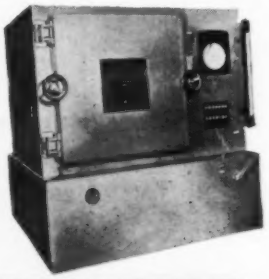

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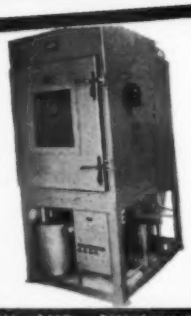

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Member of Environmental Equipment Institute

Standard CABINET COMPANY

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GEneva 8-1500

Missile System Survival

(Continued from Page 17)

operational equipment. The test environment for a given vibration test period must also be as or more severe than th

Unit Minutes of Failure Free Testing Required per Operational Minute

Reliability	Confidence .95	.90	.80	.50
.9999	29960	23030	16090	6930
.9998	14980	11515	8045	3464
.9997	9986	7677	5363	2310
.9996	7490	5758	4022	1732
.9995	5992	4606	3218	1386
.9994	4993	3838	2682	1155
.9993	4280	3290	2299	990
.9992	3745	3879	2011	866
.9991	3329	2559	1788	770
.9990	2996	2303	1609	693
.9980	1498	1152	805	347
.9970	999	768	536	231
.9960	749	576	402	173
.9950	599	461	322	139
.9940	499	384	268	116
.9930	428	329	230	99
.9920	375	288	201	87
.9910	333	256	179	77
.9900	300	230	161	69
.9800	150	115	81	35
.9700	100	77	54	23
.9600	75	58	40	17
.9500	59	45	32	14
.9400	48	37	26	11
.9300	41	32	22	9
.9200	36	28	19	8
.9100	32	25	17	7
.9000	29	22	15	7
.8000	14	10	7	3
.7000	8	6	5	2
.6000	6	5	3	1
.5000	4	3	2	1

(Figure 5)

flight environment for the operational time period considered. Care must be taken that the equipment wear-out portion of the life curve is well beyond the total test and flight time in the required operational environments. For this reason, special wear-out data should be compiled for use early in the program. Specific vibrational studies can be tailored for special equipment or circuitry problems as required.

END

Advertisers . . . **ATTENTION!**

NEW CLOSING DATE

for the Big April Issue preceding the IEE Annual Meeting and Equipment Exhibition in Chicago is . . .

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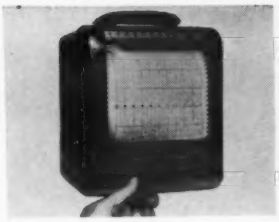
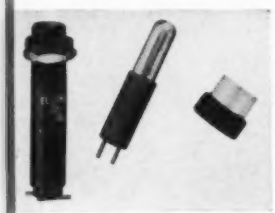
New Products

(Continued from Page 9)



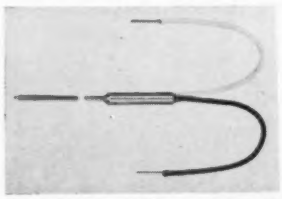
Five-inch strip-chart recorder with a variety of ranges by **Varian Associates' Instrument Division.** Automatic reference junction compensation eliminates need for external temperature reference. Chart paper has either Fahrenheit or Centigrade calibrations in each range. Weighs 16 pounds. Basic recorder can be converted to standard potentiometer input by changing input chassis.

For More Information Circle EQ RSC #11



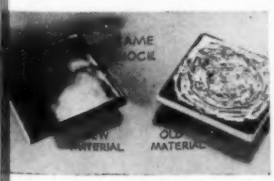
Eldema Corporation miniature replaceable-lamp indicators for equipment requiring front panel indication or readout are now available with current-limiting resistors previously available only in permanent-lamp models. Neon or incandescent lamps. Lenses plain or fluted, flat or round, wide or narrow and in several colors. Cases miniaturized to 3/8" diameter are of aluminum, black-anodized.

For More Information Circle EQ RSC #12



Con-O-Pak thermocouples, by Continental Sensing, Inc., come in metal combinations for temperatures down to −300 and up to +1,600 degrees F. Conductors are encased in specially processed ceramics. Insulation resistance between wires and sheath ranges up to 100 megohms at 500 V.D.C. and dielectric strengths to 2,000 V. A.C. Various junctions and tips are available.

For More Information Circle EQ RSC #13



Tough glass Glastcel 59, for which is claimed 30% greater resistance to thermal shock, 20% greater resistance to abrasion and extended corrosion service life, is being produced by **The Pfaudler Co., a division of Pfaudler Permutit, Inc.** Repeated heating to 450 degrees F. and quenching with water just above freezing were said not to have caused any thermal damage in lab tests.

For More Information Circle EQ RSC #14

IMPORTANT NOTICE

Environmental Quarterly Has a New Address

All advertising and editorial correspondence should be addressed to:

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ENVIRONMENTAL BUSINESS...

Mantec, Wyle Companies United In Twin Mergers

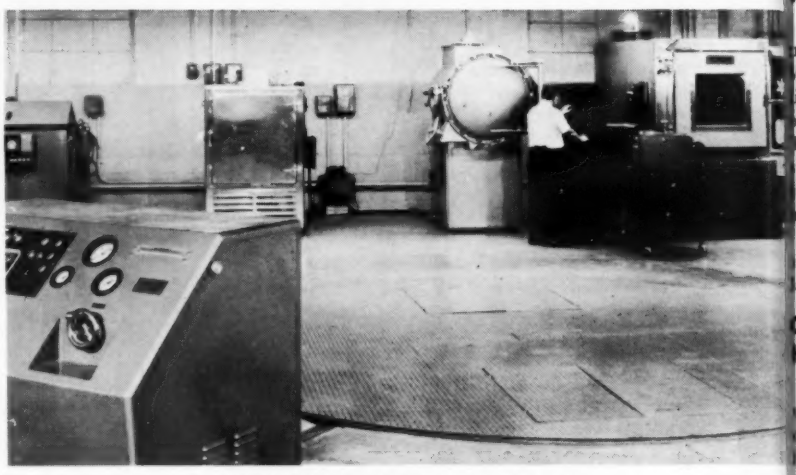
EL SEGUNDO. CALIF.—A twin set of mergers has joined two testing laboratories for missile and aircraft components and two test equipment manufacturers, all located in El Segundo.

Effective last January 5, Wyle Research Corp. was absorbed by Wyle Laboratories, creating "the country's largest missile/aircraft components testing firm," according to Frank S. Wyle, president of the surviving Wyle Laboratories. Wyle Research has specialized in testing of electrical, electronic and instrument components and systems. Wyle Laboratories formerly concentrated on cryogenics, pneumatics, hydraulics, mechancis and fuels.

On the manufacturing side, Mantec, Inc., was merged into Wyle Manufacturing Corp. and will be operated as a Wyle division. Mantec makes environmental test chambers and its business is said to have doubled in 1958. Wyle Manufacturing's "Hydrashaker," an ultra-high force vibration testing machine, is going into full scale production in several models.

Frank S. Wyle continues as president of both surviving companies. Clarence H. Wyle, who was president of Wyle Research, is now treasurer of Wyle Laboratories. Robert J. Garon, Research's vice president, has become a Laboratories vice president in charge of contracts. Other new Laboratories officers are: David D. Stone, assistant vice president, contracts; Robert S. Gardner, vice president, engineering and production; Edward Rubin, vice president, and Alvin Samuels, secretary.

Wyle Associates, also of El Segundo, continues as technical representative of both Wyle Laboratories and Wyle Manufacturing. Elmer R. Easton has been named vice president of Wyle Associates and continues as general manager.



NEW ENVIRONMENTAL TEST LAB

Two Genisco accelerators (Models 159 and 185), two Ling-Calidyne shakers and control systems (Models 44 and 177) and six Tenney Engineering chambers (walk-in Model STR-100200, stratosphere Model 36STR-100225, Tenneymite environmental Model TMVF-1.5-100240, explosion Model 3D4, rain and sunshine Model TH27-R-5 and sand and dust Model 36-S-D) are featured in the new Belock Instrument Corporation commercial environmental lab at College Point, L. I. Among the most modern in the East, the lab also has a Conrad temp-alt-hum chamber (Model FI-36-5-5), a combination salt spray, fog and humidity chamber by Industrial Filter and Pump Mfg. Co. (Model CAR-1); three shock testers, including two meeting Navy specs, from New England Trawler Equipment Co.; a Barry Corp. drop tester (Model 150-400 VD), and a radio frequency interference screen room by Ace Engineering Corp. with Empire Devices receiving equipment. The accompanying view of the Belock lab shows the control unit of one of the Genisco G-accelerators in the left foreground. The accelerator itself is beneath the floor plate in the center. The salt spray chamber is at the rear left. The three other units are Tenney's rain and sunshine, explosion and stratosphere chambers.

COMPANIES AT WORK

To LING ELECTRONICS, INC., Culver City, Calif., an initial $300,000 pilot production contract from RAYTHEON MANUFACTURING CO., Wayland, Mass., for high-power sonar transmitting equipment for the Navy . . . From SPERRY GYROSCOPE CO., Lake Success, N. Y., a $250,000 order to TENNY ENGINEERING, INC., Union, N. J., for a special chamber (12 x 14 x 18 feet on the inside, —100 to +350 degrees F., 120,000 feet altitude and ram air simulation) to accommodate a vibration machine that will generate 21,500 pounds of force up to 2,000 cycles per second . . . From the SIGNAL CORPS, a contract "substantially" adding to the $500,000 order received earlier by BJ ELECTRONICS, BORG-WARNER CORP., Santa Ana, Calif., for a high-performance radio frequency test set. Pre-production units have been okayed by the Signal Corps after rigid environmental testing, BJ Electronics says . . . WYLE MANUFACTURING CORP., El Segundo, Calif., has installed its Model W-2000 Hydrasher at NORTH AMERICAN AVIATION'S Los Angeles division for testing components of super-aircraft like the Mach 3 B-70 bomber, F-108 interceptor and X-15 manned space probe. Test requirements call for force outputs up to 20,000 pounds. . . Responsibility for evaluating functional dependability of propellant system components of the Titan missile is in the hands of BEECH AIRCRAFT CORPORATION'S Boulder Colo., division. The two-stage Titan is a MARTIN COMPANY product . . . PARKER AIRCRAFT CO., Los Angeles, has installed a completely air-conditioned and pressurized "clean room" to assemble m sile and high performance aircraft flu handling components. Workers in room even wear special shoe covers minimize dust from floor wear.

Who gives a plug? DOUGLAS AIRCRA did 25 years ago. It asked CANN ELECTRIC CO. to modify a plug de oped for the first "talking" motion p ture equipment as a quick way connect or disconnect aircraft circu Cannon has since turned out a hund million plugs for use in a compl range of extreme environmental c ditions (See EQ's Album, Page 15.)

PHILCO CORP.'s Government and I dustrial division has set up a specializ space communications systems labo tory in Philadelphia, with F. X. Rett meyer in charge. . . TASK CORP., A heim, Calif., has delivered a new l threshold, high response flight simula to the San Diego test facility of C VAIR. It is a two-axis model that acco modates components or systems up 12 x 12 x 14 inches and weighing up 50 pounds, and tests to rates of 2 deg/sec. and accelerations of 6 x deg/sec².

U. L. Approval to Blue M Water Bath Series MW-1110

BLUE ISLAND, ILL.—Blue M Electric Company's Magni-Whirl Utility Water Baths, Series MW-1110, are now listed under the reexamination service of Underwriters' Laboratories, Inc. These baths feature a built-in, automatic stirring and circulating system which, it is claimed, give complete and equal agitation in all areas irrespective of load.

Other tests are currently under way in Blue M's program to win the U. L. label for all its Magni-Whirl baths.

General Vacuum Produces High-Altitude Chamber Line

EAST BOSTON, MASS.—General Vacuum Corporation, specialist in high capacity, packaged high-vacuum pumping systems, is now producing a complete line of high-altitude simulation chambers. Its Series 900 ranges from small lab units to large walk-in chambers.

Model 988, for example, is a 6 x 6 x 7' room whose pumping system is sized to reach 285,000 feet in 10 minutes. (See EQ's Album, Page 15).

The series features special feedthroughs for power, instrumentation and gas and liquid sampling, as well as locks for specimen introduction or removal. Automatic systems for recording and controlling at constant altitudes or programmed climb and descent are also available. (For more information circle EQ Reader Service Card #34.)

Role of the Environments

A view of environmental equipment's role in the staggering electronics market comes from Monroe Seligman, president of Tenney Engineering, Inc., one of the bigger test chamber manufacturers. Noting that total sales volume of environmental units went from around 4½ million dollars in 1952 to 7½ millions in 1957 and probably topped 8½ millions last year, Mr. Seligman said in a year-end statement that he believes "the electronics industry, especially that part in aircraft and missile components, is the biggest customer for environmental chambers."

The Tenney executive said that '58 began "with 600 degrees F. regarded as a top temperature for climate simulators and ended with 1,200 degrees in a huge chamber delivered to McDonnell Aircraft Corp."

He added that the McDonnell unit's ultimate altitude of 125,000 to 150,000 feet "is already earthbound in terms of what is being sought—engineers are at work on 500,000 feet and are talking about a million feet at extremes of temperature."

ITEMCO, Managed by Al Deeb, Is New Equipment Manufacturer

PORT WASHINGTON, N. Y.—Newest manufacturer of a range of combined-environment test units is ITEMCO, Inc.—which stands for International Test Equipment Manufacturing Co. With Thomas Loffman as president and Al Deeb as general manager and sales manager, (See EQ's Album, Page 14), the company has been in production at 4 Manhasset Avenue since last June.

Mr. Deeb, former general manager of International Radiant Corp., helped to organize the Environmental Equipment Institute. Raymond Dzelkalns, chief engineer, Edward Migliore, assistant chief engineer and a number of other key ITEMCO people were with Mr. Deeb at International Radiant.

ITEMCO is manufacturing temperature, humidity, temp-alt, temp-alt-hum, salt spray, sand and dust, liquid shock test and walk-in chambers, low-high temperature test chests and other environmental equipment.

MAXIMUM CAPACITY...MINIMUM SIZE...for Environmental Testing

Model ASU-120-6-HC Altitude Test Unit

New 6 cu. ft. model for program testing with a temperature range of plus 300 to minus 100°F and a thermal capacity of 1200 BTU/hr. at −100°F. Equipped with temperature and altitude recording controllers. Altitude range at sea level to 90,000 feet. Chamber adapted to vacuum testing, and equipped with Fin Coil & Blower plus 2000-watt heater for mechanical air convection and optimum heat transfer.

Model A-120-2

This 2 cu. ft. unit is ideal for close temperature control testing of parts, equipment, finishes, etc. Has a range of minus 120° to plus 300° F., with a frost-proof observation window in hinged lid and interior illumination. Indicating control, fin coil and blower circulator and a 500 watt heater.

Cincinnati Sub-Zero offers a complete line of chambers designed for testing under conditions of low temperature, high temperature, various altitudes, atmospheric pressures, and humidities or combinations of these in complete programs of pre-determined conditions.

Specially - built, custom - designed units can also be furnished for specific programs, complete with fully automatic controls. Their flexibility offers an accurate method of simulating varying conditions for preset time intervals. For complete details, write us and outline your testing requirements.

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The ENVIRONMENTAL INDUSTRY COMES OF AGE

by Dr. George D. Wilkinson

General Manager, Environmental Equipment Institute

With this issue of "Environmental Quarterly" the Environmental Equipment Institute turns over publication rights to a new and completely independent firm, Environmental Publications, Inc. In doing so, the Institute marks the culmination of the first phase of its own growth and development.

At the founding meeting, when representatives of seven manufacturers of environmental test equipment decided to form the Institute, they outlined their objectives. They wanted recognition for environmental testing and stability for their industry. To accomplish these ends, they planned to publish a magazine, hold meetings at which technical papers could be presented, and to establish a Fair Trade Practice Code for the industry.

All of these objectives have now been accomplished. The Fair Trade Practice Code was approved by the Federal Trade Commission last year. The plans for holding technical meetings developed far beyond the first dreams of the foundi members. Engineers from all parts of the country respond to the announcement for the first meeting.

IEE Grew Out of Technical Meeting

Out of that response came first the Science Section of EEI, a subsidiary group. When this group became act enough, it developed into the Institute of Environmen Engineers, an autonomous organization cooperating with EEI and receiving financial support from the EEI. The logi final step in this development came last Fall when the offic of the Institute of Environmental Engineers announced t they were ready to assume full financial responsibility their organization.

In the final joint meeting of the representatives of two organizations, the spheres of activity of the two grou were defined. The IEE had been in complete charge of technical meetings for several years. The EEI turned o to it also the management and operation of the Ann Equipment Conference, but decided to retain to itself rights to publish *Environmental Quarterly*. Its purpose keeping the Quarterly was to insure continuous publicati of a magazine which had become recognized as the voice both engineers and manufacturers.

Although the IEE announced its intention of putting its own publication, the representatives of the EEI fea that some time would elapse before the officers of the I would be able to effect this part of their program.

The 'Quarterly' Becomes Independent

With the IEE an independent and self-supporting organi tion, the next step was to evaluate the position of Quarterly. At their Fall meeting, members of the EEI plored the matter. It was agreed that the limited staff of Institute could not do justice to the needs of the growi magazine. Accordingly, the members appointed a commit to investigate the possibility of finding a publisher willi to assume responsibility for continuing the publication a for increasing its size and scope.

The principals of Environmental Publications, Inc., ha satisfied the committee that they are able to take over magazine at its present stage of development and carry forward. In the course of the negotiations and in turning o the files and records, I have had several meetings with the and I am enthusiastic about the prospects of the Quarterl future under their guidance.

I, personally, cannot look at the passing of the Quarte from my office without some regret. It has been a long ro from my first offset issue to the handsome copy in which t

(Continued on Page

ENVIRONMENTAL TESTING

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LITERATURE FOR ENVIRONMENT...

Two from **The Bristol Company.** Bulletin Y1906 describes charts, including pre-printed photo charts for oscillographic recording, for special requirements of manufacturers or users of special instruments. (Circle Environmental Quarterly's Readers' Service Card #15). Another bulletin describes the company's training school for instrument engineers and technicians, including a general instrument course, a telemetering service course, an advanced telemetering course and courses on pneumatic instruments and self-balancing bridges and potentiometers (Circle EQ RSC #16).

* * *

Tube Turns division of **Chemetron Corporation** gives complete dimensional data on its full line of Tube-Turn stainless steel welding fittings and flanges in revised Catalog TT600. (Circle EQ RSC #17).

* * *

Three bulletins for use by aviation, missile and rocket design and test engineers engaged in precise vibration analysis have been prepared by **MB Manufacturing Co.** They cover vibration testing for sinusoidal and complex motion testing with force ratings from 1,200 to 2,500 lbs; from 1,700 to 5,000 lbs., and from 5,000 to 25,000 lbs. (Circle EQ RSC #18, 19, or 20, respectively).

* * *

Avco Research and Advanced Development describes its new Avco Kerr cell shutter for photography at exposures down to .01 of a microsecond in one brochure (Circle EQ RSC #21), and two new hypervelocity recording devices in other bulletins (Circle EQ RSC #22). The latter are a rotating mirror camera and a rotating drum camera for use in hypersonic tunnels, rocket-powered supersonic tunnels, shock tubes, hot shot tubes and plasma generators.

* * *

A new, 175-page catalog showing more than 450 different pieces of apparatus and instruments has been published by **Labline Inc.** (Circle EQ RSC #23). Included are such items as constant temperature baths, drying ovens, bench and floor model centrifuges constant temperature cabinets and environmental units for humidity, altitude and low temperatures.

* * *

A special booklet issued by **The Felters Company** gives "Facts about Anchoring Your Machines with Unisorb" (Circle EQ RSC #24). It stems from a long study on engineering vibration control and isolation for all types of machinery.

* * *

Koehler Aircraft Products Co. has begun issuing a regular series of application data sheets, "Fluid Facts." The first features KOEHLER/Dayton valves available for the handling of LOX and other cryogenics. (Circle EQ RSC #25.)

* * *

New information sheets on its Models 64 and 66 cabinet cloth filter dust collectors have been published by **Torit Manufacturing Company.** These are self-contained units in the 500 cfm range. (Circle EQ RSC #26).

* * *

Bulletin 102 which describes Tol-Check, a new instrument for rapid checking of the tolerance accuracy of surface plates, is now available from the **Herman Stone Company.** (Circle EQ RSC #27).

* * *

From the **Partlow Corporation** comes a four-page folder describing its new line pneumatic temperature controls for a wide variety of heating appliances. The models provide temperature indication or recording. (Circle EQ RSC #28).

* * *

Facilities of a modern fluids laboratory for calibration of flow measuring devices and determination of physical properties of fluids are described in Specification Sheet 10-1030 issued by **Fischer & Porter Company.** (Circle EQ RSC #29).

(Continued on Page 27)

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Altitude Performance Testing

(Continued from Page 13)

conditions can be realized by programming the rate of flow from the main tank to simulate the engine consumption rate (Fig. 2). This method would produce cyclic shut-off of the level control valve just as would occur in the aircraft if the transfer pumps provide the required flow rates. The recirculating fuel re-enters the auxiliary tanks over baffles to prevent turbulence effects on the pumps under test.

The test is conducted by initiating all the pumps under test and the recirculation pump, starting the altitude program and the recording instrumentation. Duplicate instrumentation is used where possible. Pump discharge pressures and pressure altitude are visually recorded from manometers and electronically recorded from pressure transducers. Flow data are recorded from electronic turbine flowmeters on an oscillograph and are totalized with electronic counters. Power consumption data of each pump are recorded periodically throughout the test.

The test data is presented as comparison with Figures 2 and 3. In addition, each pump's discharged quantity vs. time is presented as a comparison with the integrated flow rate vs. time curve of Figure 3. This latter presentation is useful in the instance that flow rate vs. time is not met throughout the test and is useful to determine amount of depletion of the main tank at completion of the climb (it is not always necessary to maintain the main tank full.)

Of the methods of individual pump testing, the pre-set line loss "climb to altitude" method provides the best general simulation of flight installation conditions and in many instances, depending on particular installation, the results wo preclude the use of other methods.

The pumping system aspect of testing, as presented or use of a complete scale mock-up of the sub-system that be used in an altitude chamber, best provides the means meeting the necessity for laboratory evaluation under si lated flight installation conditions. This aspect has the gene advantages of incorporating full simulation of line loss ch acteristics and interaction of the pumps in the sub-system.

END

Industry Comes of Age

(Continued from Page 22)

message appears. It was not easy to start from scratch a develop a magazine attractive enough to interest priv capital. Just because it has meant worry, trouble, and ha work, the Quarterly has become dear to me, and I am tr sorry that this marks the end of my formal connection with But the decision of the members was a wise one, and one w which I thoroughly concur. Growth means changes, and w my interest in the growth of the magazine, the professi and the industry, I am in favor of this change.

The Road Ahead for the EEI

In turning over control of the magazine to the new pu lishers, I wish them the best of success. They bring to enthusiasm, professional know-how, and a knowledge of problems of the field. I am sure they will give the reade which group I now join, and the advertisers a magazi which will continue to grow and exert an influence for go in the field of environmental testing and simulation.

The Environmental Equipment Institute thus marks end of the first stage of its development. The pioneering over. EEI has established an organization of engineers an mouthpiece for everyone interested in environmental testi and simulation. It has now reached maturity and can turn attention to normal trade association activities, with mo emphasis upon service to its members and increasing stabil of the industry.

END

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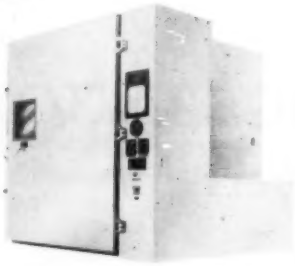

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eople You Know...

CHANGING ENVIRONMENTS

AX A. PAPE, senior research engineer for the LOCKHEED issile systems division, Sunnyvale, Calif., has been named ecretary-treasurer of the recently-organized Interamerican niversity of Saltillo, Coahuila, Mexico. Dr. Pape is a mem- r of the Institute of Environmental Engineers, the American ocket Society, the American Association for the Advance- ent of Science and the American Astronautical Society. (See EQ's Album, Page 15.)

* * *

he new executive vice president of BARRYMOUNT CORP. SHELDON E. (Shelly) YOUNG, who was general manager this wholly owned subsidiary of Barry Controls, Inc., for ur years. With headquarters in Chicago, one of his jobs is field a force of factory-trained specialists in shock mount- g of electronic and industrial equipment. Barrymount arkets Barry's products in a nine-state central region and s new branch sales offices in Detroit and Dayton.

* * *

EE D. WEBSTER has been elected vice president and sec- tary-treasurer of LING ELECTRONICS, INC. of Los Angeles. e is also finance officer, a new post, with responsibility for dministering a company-wide accounting policy and assisting oard Chairman James J. Ling and President Cameron G. erce in developing long-range policy. A specialist in merg- s, acquisitions and corporate reorganization, he formerly as financial analyst for Dresser Industries, Inc.

* * *

he appointment of PAUL M. KUEFLER as vice president of ENISTRON, INC. has been announced by President Fred ichols. Genistron, subsidiary of Genisco, Inc., is a West os Angeles manufacturer of radio interference filters. uefler is a former general manager of Cornell-Dubilier Elec- ic Corp.'s West coast division.

* * *

an expansion of its developmental engineering department, ENNEY ENGINEERING, INC., Union, N. J. environmental hamber manufacturer, has moved ROBERT LEHMAN up om engineering to be an assistant development engineer nd has added FREDERIC FROELICH to the staff with the me title. Both have been assigned to a "proposal group" eaded by FRED HERMANN, while MARTIN S. SCHLET- ER, FRANK H. GARDNER and THOMAS L. WARREN omprise a new "sales engineering group." With Schletter lso responsible for sales promotion, trade shows and new ompany literature, the new set-up streamlines customer ervice under Sales Vice President ROBERT H. BROWN.

* * *

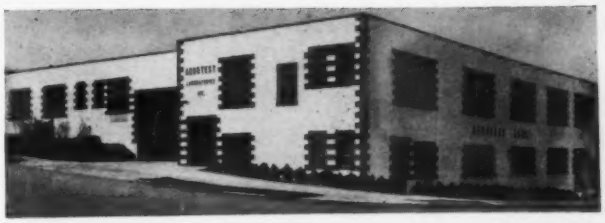
V. C. VanLEUVEN, Midwest regional sales manager of THE RISTOL COMPANY socket screw division since 1956, is ow the division's sales manager and has shifted from Detroit the home office in Waterbury, Conn. RALPH T. MUELLER, f St. Louis, is his successor in the Midwest.

* * *

RTHUR W. MILLER, production expert who spent many ears with Bucyrus Erie and the Sandia Corporation, has been ppointed vice president and general manager of ULTRA- YNE, INC. The company makes pressure transducers and lectromechanical products in Albuquerque. (See EQ's Album, age 15.)

* * *

OHN M. PEARCE, former vice president and general man- ger at Hoover Electronics, has been named manager of lectronics requirements at THE MARTIN CO. This is a new orporate post. Pearce headed Martin's electronics depart- ent in Baltimore from 1947-52 during the conception and evelopment of the Matador tactical missile. (See EQ's Album, age 15).



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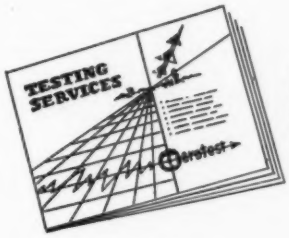

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Welcome Reader

(Continued from Page 1)

manuscripts. Articles may be original, especially prepared for Quarterly, or they may be based on papers delivered at a meeting or used for a similar purpose. Beginning with this issue, Quarterly is paying for original articles. If you have written something, are writing, or plan to write, or if you have any ideas you think someone else might develop, tell us so that we can advise you how best to proceed. Our new mailing address is P. O. Box 2583, Grand Central Station, New York 17, N. Y.

• ENVIRONMENTAL QUARTERLY is a journal of news, and a good part of this issue is given over to just that. Note, for example, the departments headed "Around the Environs" (news of a general nature in and related to the environmental field); "Environmental Business" (which deals with the commercial side of the industry); "People You Know" (got a new job? Got a medal? Getting married? Had a baby?). Tell us and send pictures. And . . . . the frosting on the cake . . . . "Environmental Quarterly's ALBUM" (a two-page photographic panorama). Who are our reporters? Again, you, our readers. Quarterly especially wants reports on the activities of organized groups in the field.

• ENVIRONMENTAL QUARTERLY is a journal of opinion. We solicit your views either in the form of letters or as full-blown articles. Comments on material printed in Quarterly are especially welcome to help guide future editorial policy.

• ENVIRONMENTAL QUARTERLY is a journal of ideas. In this category we place the description of a tailor-made test bench presented on Page 16, the new products in the column that begins on Page 8, and the summary of helpful "Literature for Environment." If you haven't already done so, put Quarterly on your mailing list for all such information.

• Finally, ENVIRONMENTAL QUARTERLY is an advertising medium! With a pinpointed circulation . . . the largest in the field . . . an interested readership and a wealth of merchandising ideas, not the least of which is its improved and simplified Reader Service Card, ENVIRONMENTAL QUARTERLY offers advertisers the best, lowest cost way to reach those who specify and buy for environments.

• Environmental simulation has a unique role in mankind's breathless rush into the space age. The challenge is great and without pre-

(Continued on Page 27)

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New Literature

(Continued from Page 23)

rom the same company a series of spec sheets on its line f temperature indicators, controllers and transmitters suitble for a range of from —400 to +1,000 degrees F. (Circle Q RSC # 30).

* * *

Need a slide rule? **General Industrial Co.** has just designed handy, circular one for simple calculations. It will fit nto your pocket and is free to engineers and office and lant executives, 50c to others. (Circle EQ RSC #31).

* * *

And to bring you up to date on space jargon, **Republic Aviation Corporation** has issued "Space Talk: A Down-to-arth Glossary of Astronautical Terms" from "abort" to "zip fuel" with dog house, magnetohydrodynamics and lox n between. (Circle EQ RSC #32).

* * *

U. S. Testing Co. describes its various engineering, chemcal, materials, and package testing and product quality ertification programs in Bulletin 5801. (Circle EQ RSC #33).

END

Welcome Reader

(Continued from Page 26)

ident. Impartially and accurately, ENVIRONMENTAL UARTERLY will report on how this challenge is being net. And as the fascinating envronmental field grows, Quarrly will grow, too—plans are already being studied for -monthly publication—for the benefit of everyone in envionments.

Do us and your friends a favor, won't you? If you know f anyone who should be reading ENVIRONMENTAL QUARTERLY but doesn't get it, please send us his name so that we can send him a sample copy. Just jot it down on the postage-free card bound into this issue.

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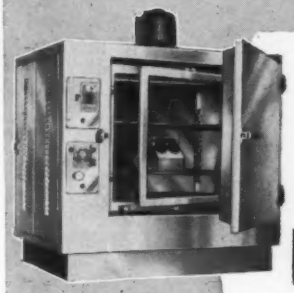

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Around the Environs

(*Continued from Page 3*)

'Combination Testing' Called Key to Future Missile Success

New combination environmental test chambers will become a reality this year and should eliminate as much as 50 per cent of recurring missile failures, a symposium meeting of the Institute of Environmental Engineers heard in New York.

In contrast with the current practice of separate testing under individual climatic conditions, "test equipment of tomorrow will be capable of controlling several environments simultaneously," Frank Gardner, development engineer of Tenney Engineering, Inc., Union, N. J., said. He added that research and design work is going to incorporate cosmic ray, ozone and solar radiation effects.

About 500 engineers, scientists, manufacturers and others attended the two-day meeting which was sponsored by the New York metropolitan chapter in the Henry Hudson Hotel. Overflow audiences heard discussions of sonic failure, laboratory management, shock pulse spectra and the characteristics of various environments among 18 technical papers. Products were displayed by 23 exhibitors.

Rear Admiral Rawson Bennett II, chief of naval research, and Lt. Col. Francis W. Campbell, chief of the air defense systems division in the mission analysis office of ARDC, were featured speakers at group luncheons on successive days.

John Regazzi, general manager of the IEE, was program committee chairman for the New York group, of which John Sexton is chairman. George Yabroudy, Bill Protz, Larry Chandler, Soc Vavoudis, Robert Rudkin and Norman Ponge all assisted.

MISCELLANY: The International Geophysical Year came to a quiet end with the departure of 1958. *The New York Times* summed it up as follows: "Probably the most thorough exploration carried out during the . . . 18-month study . . . was that of the atmosphere." An end to manned U. S. military aircraft? Observers see at least a downgrading of piloted planes in the defense arsenal after the coming fiscal year.

• • •

Navy researchers believe they formed clouds by treating air with carbon black—and then dissipated them by the same technique. The tests, which took place off the coast of Georgia, last July, are described in a report, PB 151183, available from the U. S. Commerce Department's Office of Technical Services . . . The Air Research and Development Command last month announced successful firing of a new research rocket at Fort Churchill, Manitoba, Canada. It reached a peak altitude of 260 miles with 65-pound payload. Constructed by Aerojet-General Corporation, Los Angeles, the "Spaerobee" consisted of an Aerobee-Hi liquid propellant rocket with a second stage solid propellant Sparrow.

• • •

The American Meteorological Society has moved its headquarters to a historic, century-and-a-half-old house at 45 Beacon Street in Boston.

Convair Test Chief Is Speaker At Southern Ohio IEE Dinner

Harry K. Growald, chief of engine ing tests at General Dynamics Corp Convair division in Forth Worth, w guest speaker Jan. 20 at a dinner me ing of the Southern Ohio Chapter of t Institute of Environmental Engineers.

Himself a member of the IEE, M Growald spoke on "What Is Enviro mental Engineering."

The meeting was held in the office club of Wright-Patterson Air Force Ba

Four Men in Space?

Convair division of General Dynami Corp., prime contractor of the "talkin Atlas, believes it can mount an Atl powered space station, with a crew four men, in five years. As yet the has been no word from the governme on this, but in mid-December it selecte Rocketdyne Engine divison of Nor American Aviation, Inc., Los Angel to design and build an engine capab of putting manned satellites into spa Up to 1.5 million pounds of thrust called for. The project will take four six years and cost more than 200 m lion dollars.

Incidentally, the price-tag on l month's Atlas launching was report by the *Wall Street Journal* as less th two million dollars, assembled and rea to fire.

• • •

Today's seven-billion-dollar inve ment in research and developme should hit 12½ billions by 1962, s the Scientific Apparatus Makers A sociation, and could easily reach 21 b lion dollars five years later.

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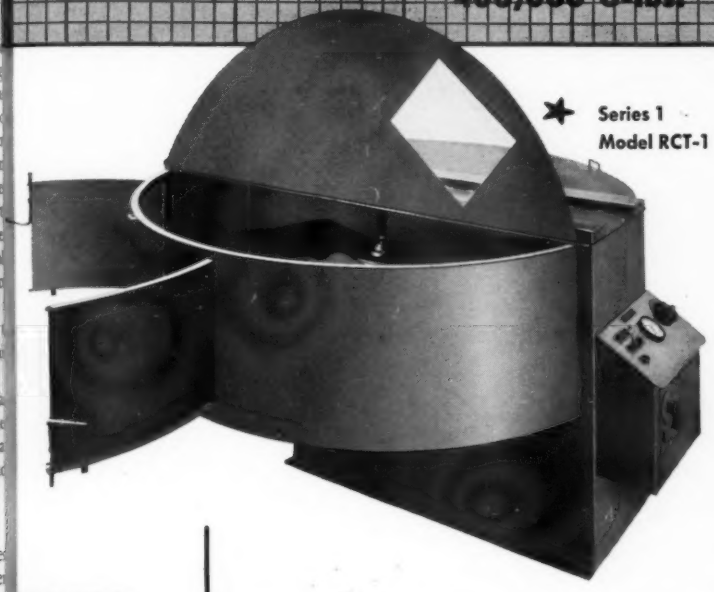

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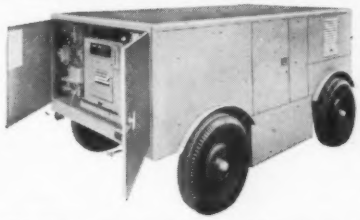

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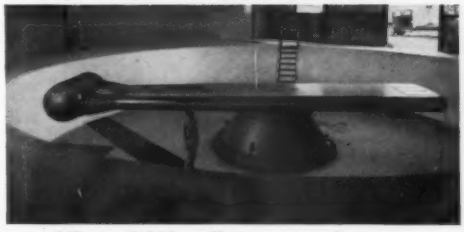
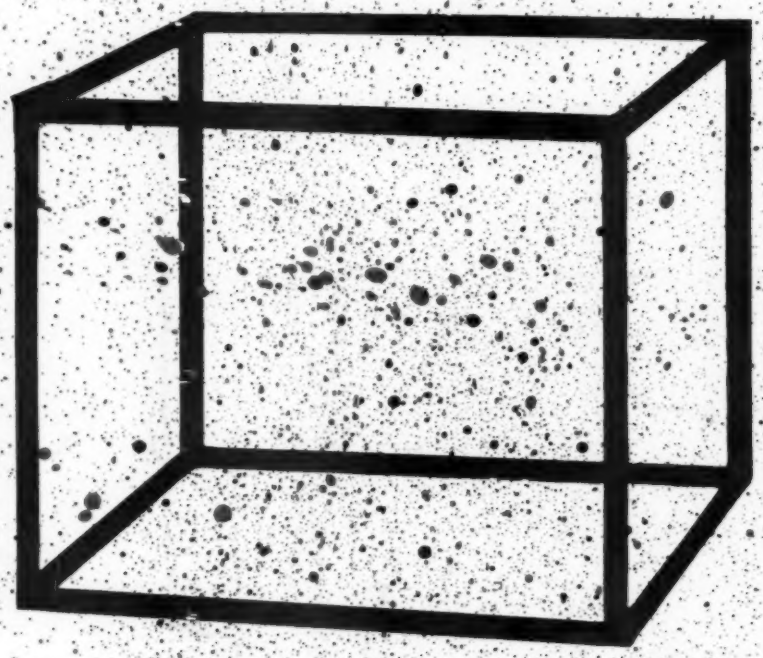


View of 22' radius arm and powerhead installed in test pit. This large Series 20 unit is designed for testing 4,000 lb. specimen at 100 G-rating.



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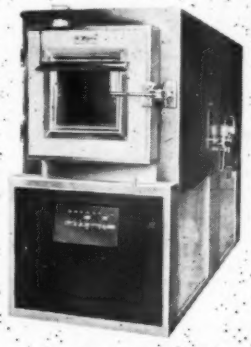

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